DEVELOPMENT OF DROUGHT RISK MAP OF ZAYANDEHRUD DAM CATCHMENT USING WATER RESOURCE APPROACH PROCESS

YOUSEF MORADI SHAHGHARYEH

UNIVERSITI SAINS MALAYSIA

2016

DEVELOPMENT OF DROUGHT RISK MAP OF ZAYANDEHRUD DAM CATCHMENT USING WATER RESOURCE APPROACH PROCESS

by

YOUSEF MORADI SHAHGHARYEH

Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

April 2016

STATEMENT

This thesis is submitted for the degree of Doctor of Philosophy at the Universiti Sains Malaysia. It is the result of my own work and contains not anything which is the outcome of work done in association except where precisely specified in the text.

Yousef Moradi Shahgharyeh

DEDICATION

This thesis is dedicated to the soul of my late Mother and my Father for their endless inspiration and moral support during all my life, to my wife for patience and stands with the long my absence, to our children in who's their innocent look.

ACKNOWLEDGEMENTS

It is a preference to thank those people who assisted me to fulfil this thesis.

Firstly, I am very appreciative to my supervisor; Professor Ir. Dr Md Azlin Bin Md. Said and CO-Supervisor Professor Dr Ismail Bin Abustan, for their guidance in direction and technique throughout my PhD and also particular thanks are due for their valuable comments on the first draft of the dissertation.

Especial thanks to Professor Dr S. Eslamian field supervisor and Associated Professor M. Nasri for their endless energy during site and field investigation and also their excellence and immense discussion.

Thank you to my colleagues in the department of disaster management governor office of Esfahan province, with whom I was able to discuss and share ideas. I am also indebted to many others in the Esfahan Regional Water Company (ERWC), particularly to Mr Asadi, Department water resource investigation for their support in building and installation of field equipment.

Finally, I would like to thank H. Nakhkob, for his support, his essential work in collection of survey and control field data.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AR	Autoregressive
BMI	Bhalme and Mooley Index
CMI	Crop Moisture Index
CN	Curve Number
D	Drought Duration
DEM	Digital Elevation Model
DGPS	Differential Global Positioning System
DM	Drought Magnitude
DRA	Drought Risk Assessment
DTMs	Digital Terrain Models
EARC	Esfahan Agricultural Research Centre
ENSO	El Nino and Southern Oscillation
EVM	Extreme Value Model
GAHP	Gamma Highest Probability
GIS	Geographical Information System
GS	Ghalehshahrokh Station
GSI	Geological survey of Iran
IA	Integrated Assessment
IAERI	Iranian Agricultural Engineering Research Institute
IAMs	Integrated Assessment Models
IBWT	Interbasin Water Transfer
ICM	Integrated catchment management
IDNDR	International Decade for Natural Disaster Reduction
IPCC	Intergovernmental Panel on Climate Change(
IWMI	International Water Management Institute

IWRM	Integrated Water Resource Management
LCk	L-Coefficient of Kurtosis
LC-LU	Land Cover and Land Use
LCs L	L-Coefficient of Skewness
LCv	L-Coefficient of variation
LiDAR	Light Detection and Ranging
LMRDs	L-Moment Ratio Diagrams
LR	Langan River
MDP	Maximum Daily Precipitation
MLE	Maximum Likelihood Estimates
MRRA	Multivariate Regional Regression Analysis
MRRMs	Multivariate Regional Regression Models
MSE	Mean Squared Error
NCDC	National Climatic Data Centre
NDMC	National Drought Mitigation Centre
NRI	National rainfall index
PA	Precipitation anomaly
PAC	Precipitation anomaly classification
PDSI	Palmer Drought Severity Index
PN	Percentage of normal
PNP	Percent of Normal Precipitation
PR	Pelasjan River
RDI	Reclamation drought index
RFFA	Regional Flood Frequency Analysis
RS	Remote Sensing
RVI	Rainfall Variability Index
S	Severity

SAR	Synthetic Aperture Radar
SCI	Statistical Centre of Iran
SCS	Soil Conservation Systems
SNHT	Standard Normal Homogeneity Test
SPEI	Standardised Precipitation Evapotranspiration Index
SPI	Standardised Precipitation Index
SR	Samandgan River
SS	Suspended Solids
SSFI	Standardised Streamflow Index
SSI	Standardised Soil Moisture Index
SWSI	Surface water supply index
SWSI	Surface Water Supply Index
TM	Thematic Mapper
UNEP	United Nations Environment Programme
USGS	United States Geological Survey
VIF	Variance Inflation Factor
WDS	Water-Distribution System
WRAP	Water Resources Approach Process
ZD	Zayandehrud Dam
ZDC	Zayandehrud Dam Catchment
ZR	Zayandehrud River

PEMBANGUNAN MAP KEMARAU RISIKO ZAYANDEH RUD DAM TADAHAN AIR MENGGUNAKAN SUMBER PENDEKATAN PROSES

ABSTRAK

Tujuan utama kajian ini adalah untuk menambahbaik metodologi untuk menilai tren kemarau dan memahami kaedah yang sesuai, bergantung kepada keadaan sebenar kawasan tadahan untuk mengurangkan impak kemarau. Sebanyak 15 stesen meterologi dan 9 tolok aliran air di sekitar Tadahan Empangan Zayandehrud (ZDC), di tengah Iran telah pilih untuk dianalisa. Rangka kerja yang dipilih untuk kajian ini ialah model Proses Pendekatan Sumber Air (WRAP), satu teknik hybrid, data geologi dan morfometri di gunakan untuk lebih memahami impak dan tren kekurangan air. Penilaian index kemarau meteorologi sedia ada, iaitu Indeks Hujan Piawai (SPI), Indeks Skor Z (ZSI) dan Desil telah gunakan untuk menilai kesesuaian penentuan keadaan kemarau. Penggunaan Indeks Hujan Piawai (SPI) didapati sesuai untuk menilai kemarau meteorologi di Iran. SPI juga sesuai untuk mengenalpasti titik permulaan dan tamat sejarah kemarau. Untuk menganalisa aliran, Indeks Aliran Piawai di gunakan. Beberapa plot serak dan rajah lengkung SPI dan SSFI nenunjukkan keputusan yang berkait rapat. Penilaian hujan, ujian, Mann–Kendall (MK), cerun Sene dan ujian LOWESS digunakan untuk menganggar signifikan tren temporal kedua-dua hujan dan aliran. Satu proses parametrik separa dan parametrik berkaitan dengan kaedah anggaran bergerak berintegrasi autoregresi pecahan dan ujian penskalaan MK digunakan untuk menilai signifikan tren temporal. Keputusan kajin untuk majoriti aliran siri masa berbanding hujan dalam masa kemarau menunjukkan tren selari, menunjukkan majoriti air larian pada masa susulan yang pendek dan kurang aliran penyusupan ke hilir. Kebanyakan stesen hujan dan tolok aliran menunjukkan tren meningkat. Perubahan yang tinggi berlaku di sebelah barat